REMARKS

Claims 7, 10, 11, 13, 14, 16-20, and 24-26 are now pending in the application. The Examiner is respectfully requested to reconsider and withdraw the rejections in view of the remarks contained herein.

REJECTION UNDER 35 U.S.C. § 103 – RAVINOVITCH IN VIEW OF KRAFT

Claims 7, 10, 11, 13, 16, 17, 19, 20, and 24 are rejected under 35 USC 103(a) as being unpatentable over Ravinovitch et al. (US Pat. No. 4,424,292) in view of Kraft et al. (US Pat. No. 4,056,397). This rejection is respectfully traversed.

Independent claims 7, 11, 16, 19, and 20 are to a film, article of architectural siding, coated article, and an article, each having an infrared reflective pigment in a sufficient amount so that there is essentially no transmittance of light of near infrared wavelength through the film or layer. The film can be about 1 mil to about 20 mils thick, from 2 mils to 5 mils thick, and can be a roll of film with a paper backing. The present invention also includes architectural siding and articles having a layer of poly(vinyl chloride) polymer, at least one plasticizer, and an infrared pigment in a sufficient amount so that there is essentially no transmittance of light of near infrared wavelength.

A skilled artisan would not find the present invention obvious in view of the Ravinovitch and Kraft references. Ravinovitch discloses a reduction of heat buildup in a vinyl polymer composition by employing a visibly black but infrared reflecting pigment. However, "Ravinovitch does not teach the claimed thickness" of the present invention (Office Action from 03/30/2006, page 3) and the addition of the Kraft reference still does not disclose the film thickness of the present invention. Furthermore, the Kraft

reference merely discloses increasing visible whiteness by varying film thickness, and whiteness is not synonymous with IR reflectance.

Kraft generally discloses photographic monosheet material having two layers bonded together. The Kraft reference includes a light reflecting "layer of binder which contains white pigments, where any white pigments may be used for this purpose provided that they have sufficient covering power without being applied in unduly thick layers." See Kraft col. 8, line 18 et seq. "The thickness of the white pigment layer may be varied according to the desired whiteness of the background. Thicknesses of from 5 to 15 μ are preferably used." These thicknesses correspond to about 0.2 to about 0.6 mil, which are still below the present invention ranges of 1 to 20 mil and 2 to 5 mil. In addition, the Kraft reference contemplates a limit to the thickness, where "unduly thick layers" are not to be used. Consequently, the Kraft reference does not teach the thicknesses used in the present invention.

The Office Action also notes that "the teachings of Kraft are drawn to a pigment reflective in the visible region and the teaching of Ravinovitch is drawn to a pigment reflective in the IR region." The Office Action takes the position the teachings of Kraft and Ravinovitch are analogous in that they both describe reflective pigment containing layers. Increasing visible light reflectivity is not synonymous with increasing IR reflectivity. For example, the IR reflective pigments used in Ravinovitch (e.g., Cr_2O_3 and Fe_2O_3) are visibly black (Ravinovitch col. 2, lines 27-30; col. 4, lines 18-24) so that increasing the amount of pigment would decrease the whiteness, which the Office Action has imputed to equal reflectivity. There is nothing in either the Kraft or Ravinovitch references that would suggest to or motivate a skilled artisan to increase

the amount of a visibly black IR reflective pigment to increase the whiteness of a pigment layer and vice versa.

In fact, the Kraft reference, when taken as whole, is focused on art that is nonanalogous to the present invention. The skilled artisan would appreciate increasing the whiteness in Kraft to mask and seal the light-sensitive layer in a photographic monosheet material. See Kraft col. 8, line 4 et seq. But, there is no reason for a skilled artisan to combine increased visible whiteness with an IR reflective pigment, where the focus is in reducing heat build up, not in protecting visible-light sensitive photographic layers. "In order to rely on a reference as a basis for rejection of an applicant's invention, the reference must either be in the field of applicant's endeavor or, if not, then be reasonably pertinent to the particular problem with which the inventor was concerned." *In re Oetiker*, 977 F.2d 1443, 1446, 24 USPQ2d 1443, 1445 (Fed. Cir. 1992). Protecting photographic emulsion layers by increasing visible light reflectivity (increasing whiteness) is not pertinent to increasing IR reflectivity to reduce heat buildup. Accordingly, the claims in issue are not obvious.

Furthermore, the amounts of pigment used in the Kraft reference versus the Ravinovitch reference teach away from combining the references. For example, the Kraft white pigment layer may contain up to 90% by weight of white pigment, based on the total mass (Kraft col. 8, lines 26-28), while the black pigment in Ravinovitch is used from only 0.25-15% (0.25 to 15 parts by weight; Ravinovitch col. 4, lines 36-39). Thus, differences in the thicknesses and the percentages would not motivate the skilled artisan to combine the references.

In addition to the preceding argument, Applicant asserts that the amount of infrared reflective pigment used in the Ravinovitch reference and the amount used in the present invention are not comparable, and any combination of the aforementioned references fails to disclose an infrared-reflective pigment in a sufficient amount so that there is essentially no transmittance of light of near infrared wavelength. Ravinovitch discloses that "the black pigment should be used at an effective level, based on the weight of the vinyl polymer or polymers in the composition." See Ravinovitch col. 4, lines 40-42; and see claim 1. In contrast, the present invention provides essentially no transmittance of light of near infrared wavelength. The Office Action concedes there is no explicit teaching of said limitations, but takes the position such a limitation is rendered obvious by Ravinovitch in that it is not inventive to discover the optimum or workable range. See Office Action 03/30/06, pages 3-4. However, the present invention is not an optimization of Ravinovitch. Instead, the present invention describes an amount of pigment that provides essentially no transmittance of IR light while Ravinovitch balances IR reflectivity against other characteristics that Ravinovitch identifies as desirable.

For example, Ravinovitch is directed toward pigments which would reflect infrared energy and which would lower the heating of the article without changing the ultraviolet protection or the color thereof. See Ravinovitch col. 1, lines 64-68. Ravinovitch, therefore, is searching for a balance and uses an effective amount of pigment to lower heat in achieving this balance between IR reflection, UV protection, and color. Thus, Ravinovitch does not provide any suggestion or motivation to use an amount of pigment to provide essentially no transmittance of light of near infrared

wavelength. Accordingly, the present invention is not an optimization of the amount of pigment of Ravinovitch. Instead the present invention expressly uses an IR reflective pigment in a sufficient amount so that there is essentially no transmittance of light of near infrared wavelength through the film. The present invention does not contain any limitation on the amount of IR reflective pigment based on color or UV protection. Withdrawal of the rejection and reconsideration are respectfully requested.

REJECTION UNDER 35 U.S.C. § 103 – RAVINOVITCH IN VIEW OF KRAFT AND SULLIVAN

Claims 14 and 18 are rejected under 35 USC 103(a) as being unpatentable over Ravinovitch et al. (US Pat. No. 4,424,292) and in view of Kraft et al. (US Pat. No. 4,056,397) and Sullivan et al. (US Pat. No. 6,416,868). The rejection pertains to claims dependent on independent Claims 11 and 16. Claims 14 and 18 are patentable over the references, as the preceding arguments have demonstrated that Claims 11 and 16 are not obvious in view of the Ravinovitch and Kraft references, and hence all pending dependent claims are thereby not obvious. If an independent claim is nonobvious under 35 U.S.C. 103, then any claim depending therefrom is nonobvious. *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988).

In sum, Ravinovitch and Kraft do not disclose the film thickness of the present invention; nor does Ravinovitch disclose using the infrared-reflective pigment in a sufficient amount so that there is essentially no transmittance of light of near infrared wavelength. Addition of Sullivan, which describes an IR coating on a metal substrate, therefore cannot render claims 14 and 18 obvious, as the aforementioned features are

still missing from the combination. Withdrawal of the rejection and reconsideration are respectfully requested.

<u>REJECTION UNDER 35 U.S.C. § 103 – STAMPER</u>

Claims 7, 10, 11, 13, 16, 17, 25, and 26 are rejected under 35 USC 103(a) as being obvious over Stamper et al. (US Pat. No. 4,574,103).

This rejection was previously presented verbatim in the Office Action from February 27, 2006. Applicant's Reply filed March 14, 2006 sought to traverse the rejection; however, nothing in the latest Office Action from March 30, 2006 indicates that Applicant's Reply was considered. Applicant respectfully re-submits the following arguments in order to traverse the rejection.

The Stamper reference discloses a two-layer vinyl chloride laminate having a first layer containing titanium dioxide and a second layer containing antimony trioxide. The first layer containing the titanium dioxide pigment improves the weatherability and resistance to sunlight, and the second layer contains antimony trioxide as a fire retardant. "The TiO_2 containing layer protects the Sb_2O_3 layer since in sunlight Sb_2O_3 adversely affects PVC." Stamper col. 1, lines 27-39.

Titanium dioxide is widely used for its efficiency in scattering visible light, and imparting whiteness, brightness, and high opacity when incorporated into a plastic formulation. Moreover, the ability of titanium dioxide to absorb UV light energy can provide significant improvement in the weatherability and durability of polymer products. See Ravinovitch col. 1, lines 51-57 (describes titanium dioxide as an ultraviolet light absorber, wherein UV absorption produces heat; see also background

on titanium dioxide in DuPont Titanium Technologies FAQ, a copy of which is attached to this Reply, and which is also available on the web at http://www.titanium.dupont.com/NASApp/TTPORTAL/Mediator?action=2321&reference=102511328771#13). The Stamper reference, therefore, appears to disclose the protection of an antimony trioxide vinyl chloride layer from UV absorption by blocking/absorbing UV light using a first layer of vinyl chloride containing titanium dioxide. Stamper does not mention or suggest reducing heat buildup; instead the reference is only interested in protecting the integrity of the fire retardant Sb_2O_3 vinyl chloride layer of the laminate.

Titanium dioxide, therefore, absorbs UV light and produces heat. This is contrary to the Office Action statement that it would be obvious to optimize the amount of titanium dioxide to increase the laminate's resistance to sunlight, and that such optimization would include sufficient amounts of an infrared-reflective pigment so that there is essentially no transmittance of light of near infrared wavelength through the film. See Office Action from 02/27/2006, page 5. Indeed, Stamper might teach optimization of protection from the UV component of sunlight. But, Stamper does not disclose, suggest, or motivate a skilled artisan to re-engineer the Stamper laminate to contain an infrared-reflective pigment in a sufficient amount so that there is essentially no transmittance of light of near infrared wavelength through the film, as in the present invention. Withdrawal of the rejection and reconsideration are respectfully requested.

CONCLUSION

It is believed that all of the stated grounds of rejection have been properly traversed, accommodated, or rendered moot. Applicant therefore respectfully requests that the Examiner reconsider and withdraw all presently outstanding rejections. It is believed that a full and complete response has been made to the outstanding Office Action and the present application is in condition for allowance. Thus, prompt and favorable consideration of this amendment is respectfully requested. If the Examiner believes that personal communication will expedite prosecution of this application, the Examiner is invited to telephone the undersigned at (248) 641-1600.

Respectfully submitted,

Dated: May 11, 2006

By: Anna M Budde
Anna M. Budde, Reg. No. 35,085

HARNESS, DICKEY & PIERCE, P.L.C.
P.O. Box 828
Bloomfield Hills, Michigan 48303
(248) 641-1600

WAZ/akb

DuPont Titanium Technologies
Plastics
Polymers, Light and the Science of TiO_2™

The miracles of science®

Technical Service Frequently Asked Questions - General Information

The following frequently asked questions are about general characteristics relating to titanium dioxide.

How does TiO_2 provide opacity?

What are the differences between plastics TiO_2 grades and grades used for coatings applications?

What makes one grade of TiO_2 different than another?

Can I buy a 100% TiO_2 pigment?

Why are surface treatments added to TiO_2?

What kind of surface treatments are applied to TiO_2?

Some DuPont TiO_2 grades are not treated, but still contain alumina. Why is that?

Why does one grade of TiO_2 work well within one type of resin and not in another?

What factors should be considered before selecting a grade for use in an application?

How does the opacity of TiO_2 compare with other pigments and fillers?

How does TiO_2 provide opacity?

Opacity is provided when all of the visible light that falls on a surface is scattered. TiO_2 is an efficient light scatterer. If there is enough pigment in a film or object, all light striking the surface, except for the small amount absorbed by the polymer or pigment, will be scattered outward and the system will appear opaque and white.

go to top of page

What are the differences between plastics TiO_2 grades and grades used for coatings applications?

Titanium dioxide grades used in plastics applications have several specification properties that are key to good performance in plastics. DuPont's plastics grades are tested and released against these specifications, but the coatings grades, which have their own set of unique specification properties and tests, are not.

go to top of page

What makes one grade of TiO_2 different than another?

A pigment's particle size, and/or its surface treatment distinguish one grade from another. Our plastics grades use various combinations of pigment physical characteristics and surface chemistry to provide a broad range of products, so that we can offer a grade that meets your application's needs.

go to top of page

Can I buy a 100% TiO_2 pigment?

No. Few, if any commercial grades of titanium dioxide are pure TiO_2. A small amount of alumina is added to all DuPont grades during manufacture. However, virtually all of it becomes part of the TiO_2 particle, not a surface treatment. In addition, most have inorganic, and in some cases, organic treatments deposited on the surfaces of the TiO_2 particles.

go to top of page

Why are surface treatments added to TiO_2?

Depending on end-use requirements, various surface treatments can be used to optimize pigment performance for specific applications.

go to top of page

What kind of surface treatments are applied to TiO_2?

Wet processing methods are used to modify the surface of the TiO_2 particle, including precipitation of hydrous oxides of silicon or aluminum. Organic additives can also be applied to enhance specific performance attributes of the pigment.

go to top of page

Some DuPont TiO_2 grades are not treated, but still contain alumina. Why is that?

A small amount of alumina is added to all grades during manufacture, but not as a surface treatment.

go to top of page

Why does one grade of TiO_2 work well within one type of resin and not in another?

Unfortunately, a single prescription for surface treatment does not produce a pigment having maximum value-in-use for all plastic applications. Some plastic resins are characterized by different polymerization chemistries and/or require higher processing temperatures. In these cases, a TiO_2 grade that is the best match for a set of processing requirements should be selected.

go to top of page

What factors should be considered before selecting a grade for use in an application?

In making a pigment recommendation to a customer, DuPont's approach is one of determining what grade is the best fit for the application. In addition to the type of polymer and the final product's end use, the compounding of pigment and the extrusion or part forming process to be used are important considerations.

go to top of page

How does the opacity of TiO_2 compare with other pigments and fillers?

Titanium dioxide is the most important white pigment used in the polymer industry. It is widely used because it efficiently scatters visible light, thereby imparting whiteness, brightness, and opacity. Other pigments and fillers are much less efficient because their refractive index is much lower, with some so close to that of a typical resin that they don't scatter much light at all, resulting in transparent or translucent film or parts.

go to top of page

What is pigment dispersion?

Titanium dioxide is used most efficiently and economically, that is, the value of the pigment is best realized, when its particles are well dispersed or separated in a polymer matrix. Dispersion is both the property of pigment particle separation, and the process of achieving it. Poor dispersion can cause specks and streaks and also affect surface texture, opacity and processibility of an application. Some of DuPont's plastics grades have been designed for superior dispersion performance. Consult our Plastics Application Guide or call us for a recommendation.

go to top of page

How is pigment dispersion achieved?

The primary particles of pigment tend to stick to each other resulting in aggregates and agglomerates many times the desired particle size. The object of dispersion is to reduce these larger particle groupings to an acceptable size. The principles and mechanics of dispersion can be discussed in more detail than this short answer permits. See the Performance FAQ section for a longer discussion of dispersion.

go to top of page

How does TiO_2 provide UV protection?

During outdoor exposure, a pigmented film is exposed to all available light wavelengths, including the visible and UV. But while the visible light is scattered, providing opacity, the UV is absorbed by the TiO_2 crystal. While this energy is no longer able to directly damage the polymer, it can cause the exposed part or film surface to undergo a slow deterioration process. (See next question).

go to top of page

What factors should be considered when selecting a grade for use in an outdoor application?

Over time, during outdoor exposure in the presence of oxygen and moisture, some of the UV energy absorbed by TiO_2 can be converted to chemical energy in the form of reactive chemical radicals that slowly attack the matrix polymer at the exposed surface. This process is generally referred to as weathering, during which tiny pits form around the embedded pigment particles. Observed effects include loss of gloss, lightening or 'fading' of a tinted application, and embrittlement of films or loss of physical properties in thick sections or parts. There are specific grades designed to resist, or to take advantage of this process. Consult our Plastics Application Guide or call us for a recommendation.

go to top of page

What is the effect of ambient humidity on pigment moisture adsorption?

During pigment manufacture, one of the last process steps is drying. At this point, as the pigment is packed, each dry grade's moisture content is at a minimum. During storage, studies have shown that the moisture level of a pigment equilibrates with the ambient environment.

Under warm and humid conditions, more moisture is adsorbed on a pigment's surface than in a cooler, dryer environment.

go to top of page

What are typical TiO_2 pigment moisture levels?

Pigment grades with less surface treatment and lower surface area tend to adsorb less moisture. Because pigment moisture content is affected by ambient storage conditions, including the duration of storage, it is not a product specification. However, we can offer the general statement that it is less than 0.5% as packed and its equilibrium content, depending on storage conditions, could reach 1.0%, as determined by a thermogravimetric weight loss method.

go to top of page

What are the recommended storage conditions for TiO_2 pigment?

Cool and dry storage is recommended. Direct exposure to water should be avoided.

go to top of page

Are your TiO_2 grades made with sulfate or chloride technology and what is the difference?

Titanium dioxide pigments are made by two commercial processes: sulfate and chloride. Rutile pigment can be made by either process, while anatase can only be made by the sulfate process. DuPont operates only chloride process plants. Both processes begin with titanium ore and differ in the methods used to refine it, by removing the ore's impurities, and in the pigment particle forming process. In the sulfate process, the ore is dissolved in sulfuric acid. During a number of steps, the impurities are removed and a pigmentary-size intermediate is formed for additional processing. The chloride method was developed by DuPont. In this process, the ore is reacted with chlorine gas to obtain titanium tetrachloride and metal chloride impurities which are subsequently separated from the process. Highly purified $TiCl_4$ is then oxidized at a high temperature to produce intermediate TiO_2 of excellent brightness. The oxidation step in the chloride process permits close control of particle size distribution and crystal type to make grades with high hiding power and tinting strength.

go to top of page

What are the general differences between rutile and anatase TiO_2?

Titanium dioxide is commercially available in two crystal forms - anatase and rutile. The rutile pigments are preferred over anatase pigments because they scatter light more efficiently, are more stable and are less likely to catalyze photodegradation.

go to top of page

How do I request a TiO_2 sample or place an order?

For color formulation work, or new product development and raw material testing, always request a standard sample of a DuPont grade. These samples are carefully selected to have typical properties reflective of our production process. In the Products area of this web site you can find online forms to request a sample or a price quote. To place an order please contact our regional sales offices.

go to top of page
